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Internal Assesment Test - III

Sub:	Machine Tools & Operations							Code:	17ME45B
Date:	14 / 05 / 2019	Duration:	90 mins	Max Marks:	50	Sem:	IV	Branch:	MECH(A & B)

Answer ALL FIVE Questions. Assume appropriate data where ever necessary.

		Marks	OBE	
			CO	RBT
1	Draw the Merchant's circle diagram and indicate all the forces involved in orthogonal cutting also write the expression of all the forces.	[10]	CO4	L2
2	Derive the Ernst-Merchant solution for minimum cutting force using Merchant's circle diagram.	[10]	CO4	L2
3	a. Explain chip formation with a neat diagram. b. List and explain the different types of chips with neat sketches.	[5] [5]	CO4	L1
4	A certain cutting tool during rough turning gave a tool life of 1 hour at a cutting speed of 30m/min. What will be the life of the tool when it is used at the same cutting speed for finish turning. Take n=0.125 for rough cut and n=0.1 for finish cut.	[10]	CO5	L3
5	The tool life for a HSS tool is expressed by the relation $VT^{1/7}=C_1$ and for tungsten carbide $VT^{1/5}=C_2$. If the tool life for a cutting speed of 24m/min is 128 min, compare the life of the two tools at a speed of 30 m/min.	[10]	CO5	L3

C.I. **C.C.I.** **H.O.D**

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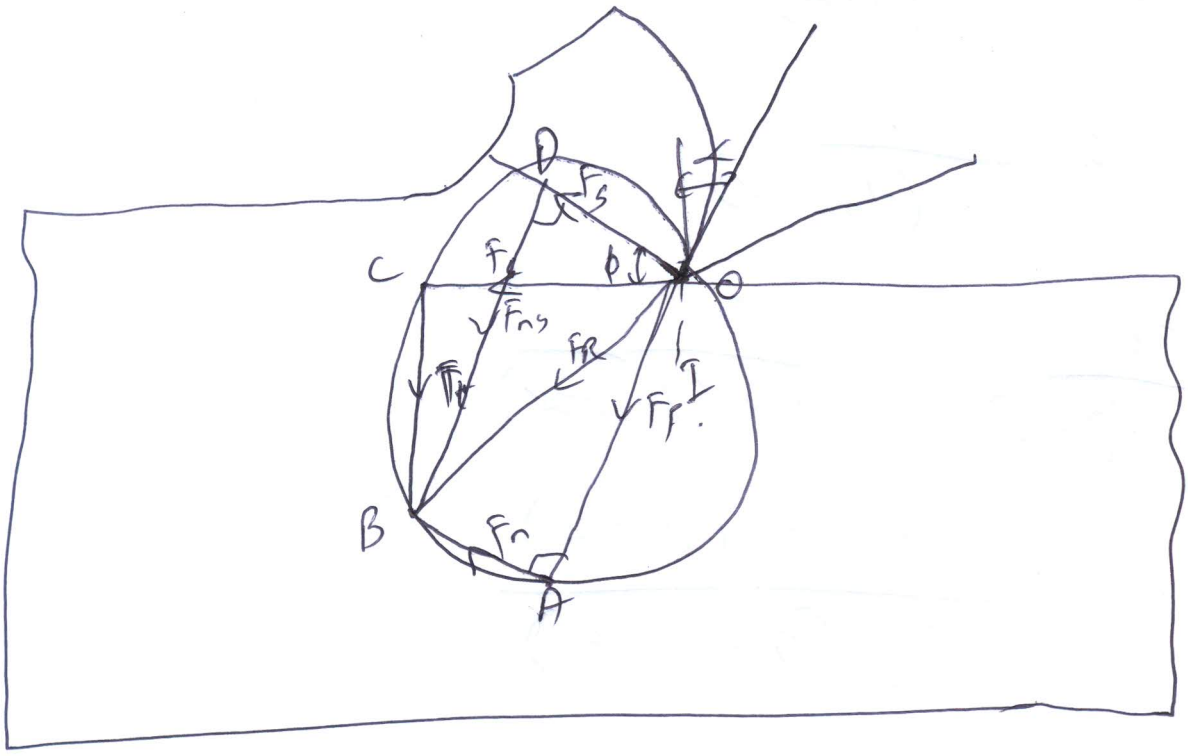
Answer ALL FIVE Questions. Assume appropriate data where ever necessary.

		Marks Distribution	Total marks
1	Draw the Merchant's circle diagram and indicate all the forces involved in orthogonal cutting also write the expression of all the forces. Completely labeled Merchant's circle diagram. Equations of all the forces involved.	 [6] [4]	[10]
2	Derive the Ernst-Merchant solution for minimum cutting force using Merchant's circle diagram. Merchant's circle diagram. Derivation.	 [4] [6]	[10]
3	a. Explain chip formation with a neat diagram. Diagram Explanation b. List and explain the different types of chips with neat sketches. Diagram Explanation	[3] [2] [3] [2]	[10]
4	A certain cutting tool during rough turning gave a tool life of 1 hour at a cutting speed of 30m/min. What will be the life of the tool when it is used at the same cutting speed for finish turning. Take n=0.125 for rough cut and n=0.1 for finish cut. Given data Equation Tool life	 [2] [3] [5]	[10]
5	The tool life for a HSS tool is expressed by the relation $VT^{1/7}=C_1$ and for tungsten carbide $VT^{1/5}=C_2$. If the tool life for a cutting speed of 24m/min is 128 min, compare the life of the two tools at a speed of 30 m/min. Given data Equation Tool life	 [2] [3] [5]	[10]

Machine Tools & Operations

IAT-3 solution (May 2019)

(1)



$$F_c = F_R \cos(\beta - \alpha)$$

$$F_t = F_R \sin(\beta - \alpha)$$

$$F_s = F_R \cos(\phi + \beta - \alpha)$$

$$F_{ns} = F_R \sin(\phi + \beta - \alpha)$$

$$F_f = F_c \sin\alpha + F_t \cos\alpha$$

$$F_n = F_c \cos\alpha - F_t \sin\alpha.$$

$$\mu = \frac{F_c \sin\alpha + F_t \cos\alpha}{F_c \cos\alpha - F_t \sin\alpha}.$$

(2) $F_c = F_R \cos(\beta - \alpha)$

$F_s = F_R \cos(\phi + \beta - \alpha)$

$$F_R = \frac{F_c}{\cos(\beta - \alpha)}$$

$$F_R = \frac{F_s}{\cos(\phi + \beta - \alpha)}$$

$$\frac{F_c}{\cos(\beta - \alpha)} = \frac{F_s}{\cos(\phi + \beta - \alpha)}$$

$$F_c = \frac{F_s \cos(\beta - \alpha)}{\cos(\phi + \beta - \alpha)}$$

$$\tau_m = \frac{F_s}{A_s}.$$

$$A_s = \frac{A_o}{\sin\phi}$$

$$\tau_m = \frac{F_s}{A_o/\sin\phi} = \frac{F_s \sin\phi}{A_o}$$

$$\Rightarrow F_s = \frac{\tau_m A_o}{\sin\phi}$$

$$F_c = \frac{\tau_m A_o \cos(\beta - \alpha)}{\sin\phi \cos(\phi + \beta - \alpha)}$$

$$\frac{dF_c}{d\phi} = 0.$$

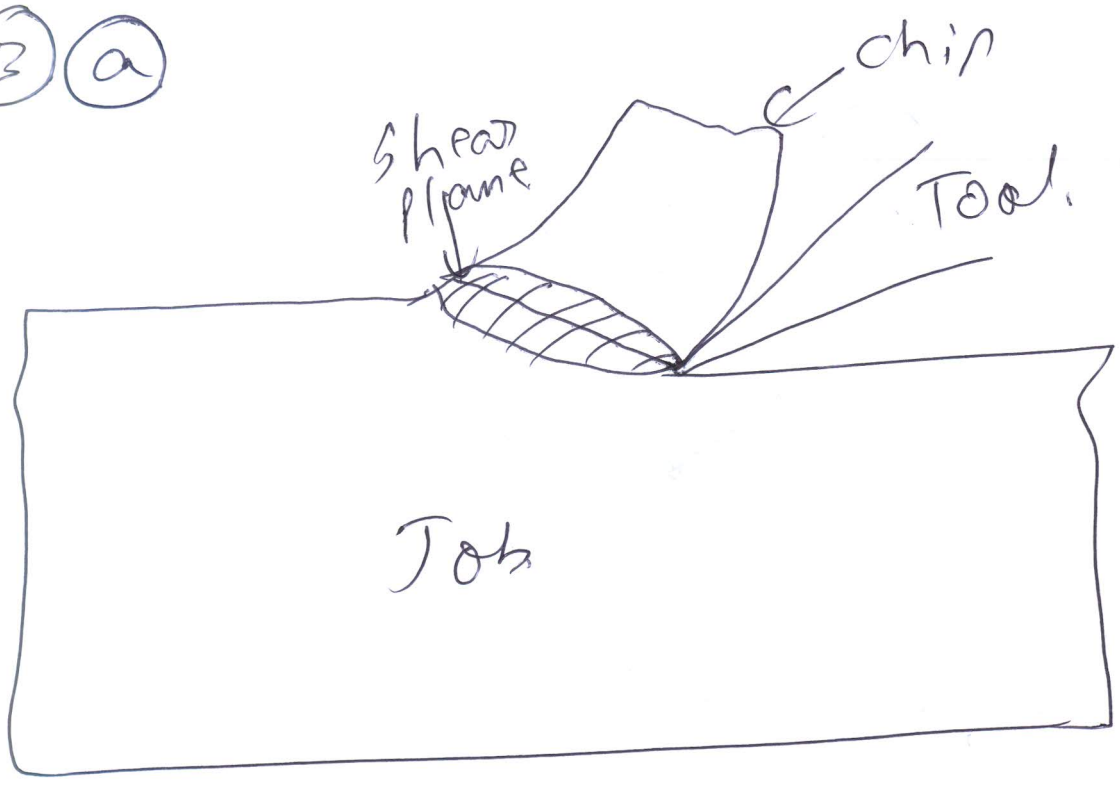
$$\cos(\phi + \phi + \beta - \alpha) = 0$$

$$2\phi + \beta - \alpha = \cos^{-1}(0)$$

$$2\phi + \beta - \alpha = \frac{\pi}{2}$$

$$\Rightarrow \boxed{\phi = \frac{\pi}{4} - \frac{\beta}{2} + \frac{\alpha}{2}}$$

(3) (a)



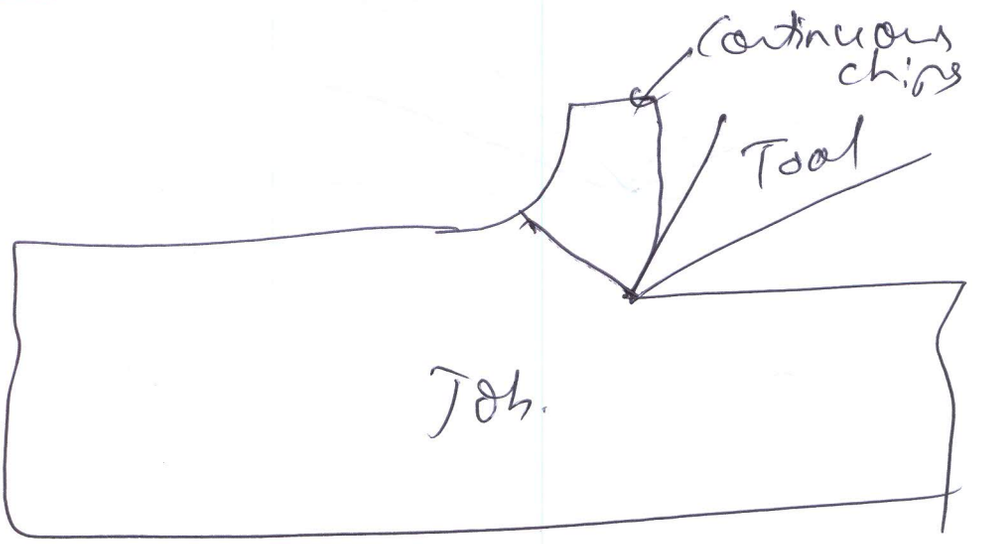
The tool is forced to move against the job during cutting, during this the tool compresses the job directly infront of the cutting edge. Because of this stress exerted on the job, the job is going to slip along the slip

plane thereby causing the formation of chip.

(3)(b) There are three types of chips:-

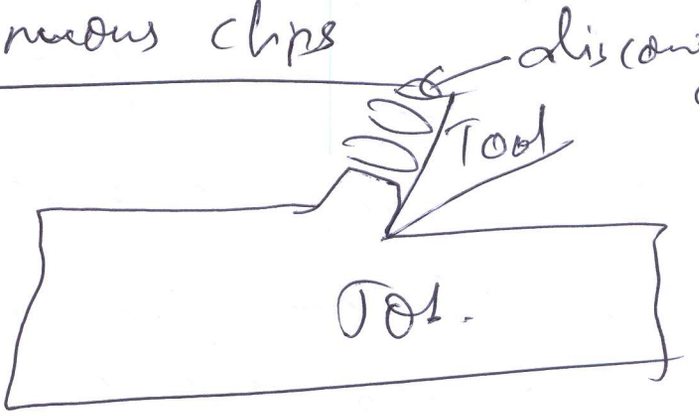
(1) Continuous chips
(2) Discontinuous chips
(3) Continuous chips with built up edges.

(i) Continuous chips :-

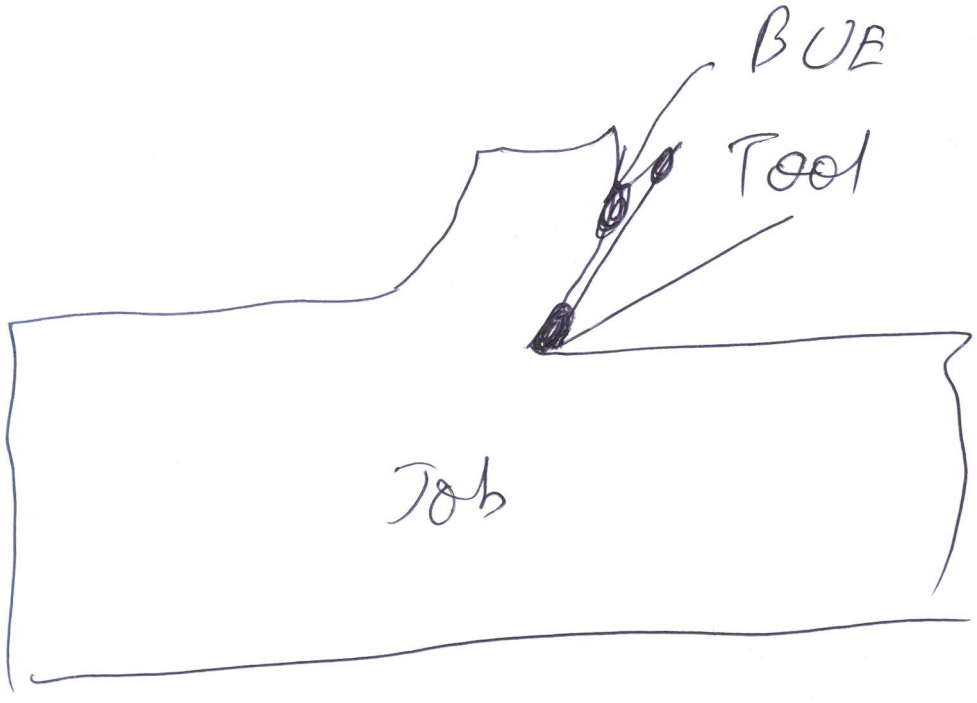


This usually occurs in ductile jobs. The collection and storage is easier

(ii) Discontinuous chips



(iii) Continuous chips with Built up edges. (5)



(4) Given:-

$T_1 = 60 \text{ min}$

$V_o = 30 \text{ m/min}$

$T_2 = ?$

$n_1 = 0.125$

$n_2 = 0.1$

$$VT_1^{n_1} = C$$

$$30(60)^{0.125} = C$$

$$\Rightarrow \boxed{C = 50.04}$$

$$VT_2^{n_2} = C$$

$$30(T_2)^{0.1} = 50.04$$

$$\Rightarrow T_2^{0.1} = \frac{50.04}{30}$$

$$T_2^{0.1} = 1.668$$

$$\boxed{T_2 = 166.70 \text{ min}}$$

(5) Given:—

$V_1 = 24 m/min$

$T_1 = 128 min.$

$V_2 = 30 m/min$

$T_{2HSS} = ?$

$T_{2TC} = ?$

For HSS tool.

$$VT^{1/7} = C_1$$

$$24(128)^{1/7} = C_1$$

$$\Rightarrow \boxed{C_1 = 48}$$

For TC tool

$$VT^{1/5} = C_2$$

$$24(128)^{1/5} = C_2$$

$$\Rightarrow \boxed{C_2 = 63.33}$$

To find T_{2HSS}.

$$V_2 T_{2HSS}^{1/7} = C_1$$

(6)

$$30(T_{2HSS})^{1/7} = 48.$$

$$\Rightarrow T_{2HSS} = \left(\frac{48}{30}\right)^7$$

$$\Rightarrow \boxed{T_{2HSS} = 26.84 min}$$

To find T_{2TC}

$$V_2 T_{2TC}^{1/5} = C_2$$

$$30(T_{2TC})^{1/5} = 63.33$$

$$T_{2TC} = \left(\frac{63.33}{30}\right)^5$$

$$\Rightarrow \boxed{T_{2TC} = 41.92 min}$$